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Changes in the structure of a savanna forest over a six-year period in the Amazon-Cerrado transition, Mato Grosso state, Brazil

Mudanças na estrutura de um cerradão em um período de seis anos, na transição Cerrado-Floresta Amazônica, Mato Grosso, Brasil

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Abstract

Vegetation changes in transition zones are still poorly studied. Changes in the vegetation structure of a savanna forest (cerradão) were assessed in the Amazon-Cerrado transition (14°42'2.3"S; 52°21'2.6"W), eastern Mato Grosso, within a period of six years (2002, 2005 and 2008). In 2002, fifty plots of 10 × 10 m were set up, where all trees with $DSH_{30} \geq 5$ cm were measured; in 2005 and 2008 the plots were re-inventoried. In 2008, 84 species from 70 genera and 37 families were sampled; absolute density was 1,998 individuals/ha and basal area was 25.95 $m^2.ha^{-1}$. On the one hand, the absolute density of live individuals decreased from 2005 to 2008 (2,066 individuals/ha); on the other hand, the basal area increased in 2008 compared to 2005 (23.56 $m^2.ha^{-1}$) and 2002 (1,884 individuals/ha and 21.38 $m^2.ha^{-1}$). The species with the highest importance value in the period were *Hirtella glandulosa*, *Tachigali vulgaris* and *Xylopia aromatica*. Except for these three species, all other species underwent hierarchic changes in the importance value, indicating that most species frequently alternate. Community structure exhibited changes throughout the period; hence, we suggest investigations on the role of *T. vulgaris* in these changes, since environmental conditions caused by gap opening from the fall of senile individuals of this pioneer species with a short life cycle may contribute to community dynamics.

Key words: structural changes, permanent plots, *Tachigali vulgaris*.

Resumo

Mudanças na vegetação em zonas de transição são ainda pouco estudadas. Foram avaliadas as mudanças na estrutura da vegetação de um cerradão na transição Cerrado-Floresta Amazônica (14°42'2,3"S e 52°21'2,6"W), no leste de Mato Grosso, em um período de seis anos (2002, 2005 e 2008). Em 2002 foram estabelecidas 50 parcelas de 10 × 10 m, medidas todas as árvores com $DAS_{30} \geq 5$ cm e em 2005 e 2008 as parcelas foram reinventariadas. Em 2008 foram amostradas 84 espécies, 70 gêneros e 37 famílias, a densidade absoluta foi de 1.998 indivíduos/ha e a área basal de 25,95 $m^2.ha^{-1}$. A densidade absoluta dos indivíduos vivos diminuiu em relação a 2005 (2.066 ind/ha); em contrapartida, a área basal aumentou em relação a 2005 (23,56 $m^2.ha^{-1}$) e 2002 (1.884 ind/ha e 21,38 $m^2.ha^{-1}$). As espécies com maior valor de importância nos períodos analisados foram *Hirtella glandulosa*, *Tachigali vulgaris* e *Xylopia aromatica*. Com exceção destas três espécies, todas as demais sofreram alterações hierárquicas no valor de importância, indicando que a maioria das espécies está se alternando frequentemente. Como a estrutura da comunidade apresentou mudanças entre os períodos estudados, sugerimos investigações sobre o papel de *T. vulgaris* nessas mudanças, uma vez que as condições ambientais ocasionadas pela abertura de clareiras em função da queda de indivíduos senis desta espécie pioneira e de ciclo de vida curto podem estar contribuindo na dinâmica da comunidade.

Palavras-chave: alterações estruturais, parcelas permanentes, *Tachigali vulgaris*.

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Introduction

The Cerrado is seen as one of the 34 biodiversity hotspots of the world (Mittermeier *et al.* 2005); it is the largest Neotropical savanna in the world and has the second largest area of all biomes in South America (Oliveira & Marquis 2002). Among several threatened physiognomies of this biome, the savanna forest ("cerradão") stands out. It is denominated 'mesophyllous sclerophyllous forest' (Rizzini 1979) and is characterized by the presence of species from savanna and forest environments. In general, this physiognomy is not tolerant of anthropic disturbance and occupies small areas; exactly the areas that are most frequently used for agriculture and livestock, since these areas are usually on soils with higher availability of exchangeable cations (Ratter 1971; Eiten 1979; Oliveira-Filho *et al.* 1994), *i.e.* more humid and with clayey texture (Marimon-Junior & Haridasan 2005).

In the eastern portion of Mato Grosso state there are patches of savanna forest in the transition zone between Cerrado and the Amazon biomes (Marimon-Junior & Haridasan 2005; Marimon *et al.* 2006). Two types of vegetation were recorded in the area: the savanna forest of *Magonia pubescens* A. St.-Hil. and *Callisthene fasciculata* Mart., which occurs on mesotrophic soils; and the savanna forest of *Hirtella glandulosa*, which occurs on dystrophic soils (Ratter 1971; Ratter *et al.* 1973). These two savanna forest types are threatened, mainly because they are located in a region known as the 'deforestation arch', where the advance of cultivated areas represents an important threat to native vegetation (Nogueira *et al.* 2008).

Most studies carried out in savanna forests are based on information collected at a point in time (Costa & Araújo 2001; Marimon & Lima 2001; Gomes *et al.* 2004; Marimon-Junior & Haridasan 2005; Guilherme & Nakajima 2007; Kunz *et al.* 2009). There is still a huge need for studies on the dynamics of this vegetation. Therefore, studies on long-term vegetation changes are essential to understand the mechanisms and processes that maintain the community in a steady state (Aquino *et al.* 2007). A lot of information obtained from native-forest functioning can be used for its management.

Hence, important subsidies to practices of conservation, management and restoration of degraded areas, for example, may come from studies on the remnants of native vegetation in Mato Grosso state. Therefore, the objective of this study was to assess changes in the structure of the woody vegetation of a savanna forest in eastern Mato Grosso, in the transition region between Cerrado and the Amazon, within a period of six years (2002 and 2008). The transition between Cerrado and the Amazon extends for over 4,500 km (Ackerly *et al.* 1989) and it is dynamic: studies show that forests are advancing over savannas (Marimon *et al.* 2006). In this context, the present study will also loot at whether floristic and structural changes in the savanna forest led this physiognomy to become a denser forest.

Material and Methods

The study was carried out in a savanna forest (14°42'2.3"S; 52°21'2.6"W), Bacaba Municipal Park, Nova Xavantina, state of Mato Grosso, central-western Brazil. According to Marimon-Junior & Haridasan (2005), the park is located in a transition region between the Cerrado and Amazon biomes, where the predominant 'cerrado *sensu stricto*' vegetation (open savanna) is in contact with forests and savanna forests, in acid and dystrophic soils, with high levels of exchangeable aluminum and clayey texture. According to Köppen's classification, the regional climate is type Aw (Silva *et al.* 2008), characterized by two well-defined seasons: one dry and cold (April to September) and the other hot and rainy (October to March).

The transition between Cerrado and the Amazon is a zone of ecological tension that exhibits a mosaic of savannas and forests (Ratter *et al.* 1973; Ackerly *et al.* 1989; Ivanauskas *et al.* 2004; Marimon *et al.* 2006). Based on IBGE (2004), our study area is about 150 km from this zone of ecological tension. However, this zone is not regular; there are larger or smaller intrusions or fringes (Ratter *et al.* 1973; Marimon *et al.* 2006), which are currently fragmented due to the conversion of native vegetation into agricultural lands (Nogueira *et al.* 2008). Although our study area is located in a vegetation matrix dominated by savanna (Marimon-Junior & Haridasan 2005), in nearby areas (less than 10 km) there are fragments and intrusions of contact between savanna and seasonal forest (IBGE 2004; Marimon 2005). Records taken out in 1943 by members of the Roncador-Xingu Expedition confirmed that up to 40 km to the south of our study area there would have existed 'a dense vegetation, where to open the way they needed to cut down colossal trees' (Carpentieri 2008); this report characterizes the study region as a zone of ecological tension or a zone of transition between Cerrado and the Amazon.

In 2002, fifty 10 × 10 m permanent plots were set up (Marimon-Junior & Haridasan 2005), where woody species (except lianas) that had DSH_{30} (diameter at soil height, measured at 30cm) e ≥ 5cm were sampled. At the occasion, all individuals were tagged with numbered aluminum plates, and were recorded and identified. Species were identified by comparison with herbaria vouchers (NX and UB) and by consulting specialists. The collected material was deposited in the NX Herbarium, UNEMAT – Nova Xavantina Campus, Mato Grosso state. In 2005 and in 2008, all surviving individuals were measured again and recruits (individuals that reached the minimal inclusion criterion) were tagged, measured, recorded and identified. Sampling and species identification followed the same procedures used in the first inventory. The classification system used for families was APG III (2009) and the revision of taxa names followed Forzza *et al.* (2010) in the list of Angiosperm species of the Brazilian flora.

Parameters of relative density, frequency, dominance and importance value (IV) were used to describe vegetation structure, following Müeller-Dombois & Ellenberg (1974). The program FITOPAC 1.0 (Shepherd 1994) was used for the analysis. We compared the phytosociology of the three inventories: 2002 (Marimon-Junior & Haridasan 2005), 2005 and 2008 (present study).

Based on the number of individuals sampled, mortality and recruitment rates were calculated for each plot (Sheil *et al.* 1995, 2000) and comparisons were made (2002-2005 and 2005-2008) using paired *t*-tests. The average number of individuals and the basal area in each year sampled were compared by analysis of variance and Tukey's test at 5% probability (Zar 1999).

Results and Discussion

In 2008, the savanna forest studied had 84 plant species from 70 genera and 37 families (Tab. 1), with an absolute density of 1,998 individuals/ha and a basal area of 25.95 $m^2.ha^{-1}$. On the one hand, the absolute density of live individuals decreased compared to 2005 (2,066 $ind.ha^{-1}$); on the other hand, the basal area increased compared to 2002 and 2005 (Tab. 2). In 2002, 77 species from 65 genera and 36 families were recorded (Marimon-Junior & Haridasan 2005) and in 2005, 87 species from 71 genera and 38 families. The increase in the basal area in two consecutive periods (2005 and 2008) in the savanna forest is consistent with Phillips *et al.* (2002), Baker *et al.* (2004) and Lewis *et al.* (2009), who observed that in the last century nearly all terrestrial ecosystems have been under the influence of atmospheric and climatic changes. An increase in dynamics, biomass and carbon stock in tropical forests was recorded, probably due to an increase of CO_2 levels in the atmosphere. Further detailed long-term studies in the savanna forest studied here are essential to verify if the increase in biomass of this community is related to the increase in atmospheric CO_2 levels. However, the increase in biomass could also be explained by climatic changes that have been occurring since the early Holocene, when a drier climate was replaced by a warmer and more humid climate (Ledru *et al.* 1996). In a study carried out by Marimon *et al.* (2006) in a nearby area, 30-year records showed that the Amazon advanced 7 km into the Cerrado, reinforcing the expansion of forests over savannas in the region.

Recruitment and mortality rates were higher in the first inventory period, between 2002 and 2005 (Tab. 2). If we consider intervals as well as the whole period (2002 to 2008), the values of the savanna forest of Bacaba Park were higher than the values observed in other studies carried out in forests of South and Central America, which varied from 0.5 to 2.8%.$year^{-1}$ for mortality (Lieberman *et al.* 1985; Swaine *et al.* 1987; Condit *et al.* 1995; Felfili 1995) and from 2 to 4%.$year^{-1}$ for recruitment (Oliveira-Filho *et al.* 1997; Higuchi *et al.* 2008; Silva & Araújo 2009; Miguel *et al.* 2011). According to Felfili (1995), mortality rates around 3.5%.$year^{-1}$ are typical of areas that underwent disturbances. Oliveira & Felfili (2008) observed that high mortality and recruitment rates lead to a high turnover, confirming the dynamic aspect of the community, which even without undertaking direct disturbances (fire and cutting) exhibited high mortality and recruitment. Considering the whole period (2002–2008), recruitment compensated mortality (t= -2.95, P= 0.0024). This compensation can be related to a 'construction' phase of the sylvigenetic cycle of the community, as proposed by Hallé *et al.* (1978), which is usually recorded in forests recovering from a disturbance (Oliveira-Filho *et al.* 1997; Chagas *et al.* 2001), suggesting that periods of higher mortality might have previously occurred (Felfili 1995), of which there is no record from the memory of local residents.

The reduction in density and the increase in basal area recorded in the present study (Tab. 2) are consistent with a self-thinning pattern, as observed by Felfili (1995) and Werneck *et al.* (2000).

Table 1 – Phytosociological parameters of species sampled in a cerradão in the Cerrado-Amazon Forest transition, in 2005 and 2008, Nova Xavantina-MT. Nº Herb.= registration number in Herbarium NX, N= number of individuals, DR= relative density (%), FR= relative frequency (%), DoR= relative dominance (%), and VI= importance value. Species listed in order of decreasing VI.

Species	Families	Nº Herb.	N 2005	N 2008	DR 2005	DR 2008	FR 2005	FR 2008	DoR 2005	DoR 2008	VI 2005	VI 2008
Hirtella glandulosa Spreng.	Chrysobalanaceae	728	120	125	11,62	12,52	6,12	6,48	25,17	27,37	42,90	46,37
Tachigali vulgaris L.G.Silva & H.C.Lima	Fabaceae	674	85	93	8,23	9,31	5,12	4,86	10,95	11,21	24,30	25,38
Xylopia aromatica (Lam.) Mart.	Annonaceae	137	74	63	7,16	6,31	5,55	5,15	7,55	7,00	20,26	18,46
Tapirira guianensis Aubl.	Anacardiaceae	59	39	42	3,78	4,20	3,70	3,98	2,95	3,86	10,42	12,04
Emmotum nitens (Benth.) Miers	Icacinaceae	1371	22	22	2,13	2,20	2,42	2,50	6,09	6,48	10,64	11,18
Myrcia splendens (Sw.) DC	Myrtaceae	2258	41	41	3,97	4,10	3,70	3,83	2,64	2,73	10,31	10,66
Chaetocarpus echinocarpus (Baill.) Ducke	Peraceae	1046	41	42	3,97	4,20	3,84	3,98	1,96	2,21	9,77	10,39
Matayba guianensis Aubl.	Sapindaceae	9518	33	35	3,19	3,50	3,41	3,83	2,04	2,15	8,65	9,48
Heisteria ovata Benth.	Olacaceae	2403	44	41	4,26	4,10	3,70	3,68	1,67	1,62	9,63	9,40
Aspidosperma multiflorum A.DC.	Apocynaceae	164	33	32	3,19	3,20	3,41	3,39	2,35	2,20	8,96	8,79
Vatairea macrocarpa (Benth.) Ducke	Fabaceae	1275	27	26	2,61	2,60	2,99	3,39	2,27	2,35	7,87	8,34
Eriotheca gracilipes (K. Schum.) A.Robyns	Malvaceae	477	25	21	2,42	2,10	2,28	2,21	4,50	3,08	9,19	7,39
Sorocea klotzschiana Baill.	Moraceae	2117	28	31	2,71	3,10	2,56	2,80	0,96	1,27	6,23	7,17
Guapira graciliflora (Mart. ex Schmidt) Lundell	Nyctaginaceae	2322	33	26	3,19	2,60	3,27	2,80	1,37	1,17	7,84	6,57
Roupala montana Aubl.	Proteaceae	2493	32	22	3,10	2,20	3,41	2,50	2,66	1,51	9,17	6,22
Alchornea discolor Poepp.	Euphorbiaceae	1032	15	17	1,45	1,70	1,99	2,36	0,85	0,93	4,29	4,99
Siparuna guianensis Aubl.	Siparunaceae	2075	18	20	1,74	2,00	1,99	2,21	0,61	0,77	4,34	4,98
Maprounea guianensis Aubl.	Euphorbiaceae	1103	14	15	1,36	1,50	1,71	1,91	0,81	1,08	3,87	4,50
Cordiera sessilis (Vell.) Kuntze	Rubiaceae	2526	16	16	1,55	1,60	2,13	2,21	0,54	0,52	4,22	4,33
Pseudobombax longiflorum (Mart.& Zucc.)A.Robyns	Malvaceae	484	14	14	1,36	1,40	1,56	1,62	0,95	0,93	3,87	3,95
Agonandra brasiliensis Miers ex Benth. & Hook. f.	Opiliaceae	2422	9	12	0,87	1,20	1,00	1,33	0,81	0,87	2,68	3,39
Erythroxylum daphnites Mart.	Erythroxylaceae	6980	17	13	1,65	1,30	1,85	1,62	0,49	0,30	3,99	3,22
Terminalia argentea Mart.	Combretaceae	846	10	9	0,97	0,90	1,28	1,33	1,02	0,84	3,27	3,07
Protium heptaphyllum (Aubl.) Marchand	Burseraceae	519	8	8	0,77	0,80	1,00	1,03	0,83	0,98	2,60	2,81
Buchenavia tomentosa Eichler	Combretaceae	833	6	6	0,58	0,60	0,85	0,88	1,02	1,29	2,46	2,78
Alibertia edulis (Rich.) A.Rich.	Rubiaceae	2513	9	10	0,87	1,00	1,28	1,47	0,23	0,30	2,39	2,77
Lacistema aggregatum (P.J.Bergius) Rusby	Lacistemataceae	1382	9	11	0,87	1,10	1,14	1,33	0,19	0,24	2,19	2,67
Pterodon pubescens (Benth.) Benth.	Fabaceae	6975	6	6	0,58	0,60	0,71	0,74	1,25	1,24	2,55	2,57

Species	Families	Nº Herb.	N		DR		FR		DoR		VI	
			2005	2008	2005	2008	2005	2008	2005	2008	2005	2008
Vochysia haenkeana Mart.	Vochysiaceae	3066	6	7	0,58	0,70	0,85	0,88	0,68	0,92	2,11	2,51
Aspidosperma macrocarpon Mart.	Apocynaceae	158	8	8	0,77	0,80	1,14	1,18	0,46	0,43	2,37	2,41
Mezilaurus crassiramea (Meisn.) Taub. ex Mez	Lauraceae	1463	4	4	0,39	0,40	0,57	0,59	1,54	1,38	2,49	2,37
Antonia ovata Pohl	Loganiaceae	1523	14	9	1,36	0,90	1,71	1,18	0,42	0,28	3,49	2,36
Coccoloba mollis Casar.	Polygonaceae	9522	9	9	0,87	0,90	0,85	0,88	0,48	0,65	2,21	2,35
Salvertia convallariodora A.St.-Hil.	Vochysiaceae	3057	8	9	0,77	0,90	0,85	1,03	0,27	0,25	1,89	2,18
Qualea parviflora Mart.	Vochysiaceae	3044	8	8	0,77	0,80	1,00	1,03	0,37	0,34	2,14	2,17
Curatella americana L.	Dilleniaceae	927	5	5	0,48	0,51	0,71	0,74	0,95	0,91	2,15	2,14
Luetzelburgia praecox (Harms) Harms	Fabaceae	1235	6	6	0,58	0,60	0,85	0,88	0,60	0,58	2,04	2,06
Dipteryx alata Vogel	Fabaceae	1219	4	4	0,39	0,40	0,57	0,59	0,86	1,01	1,81	2,00
Syagrus comosa (Mart.) Mart.	Arecaceae	3112	8	7	0,77	0,70	0,85	0,88	0,45	0,33	2,08	1,92
Guapira noxia (Netto) Lundell	Nyctaginaceae	2324	10	6	0,97	0,60	1,00	0,74	0,76	0,56	2,73	1,90
Qualea grandiflora Mart.	Vochysiaceae	3001	7	6	0,68	0,60	1,00	0,88	0,44	0,36	2,11	1,84
Astronium fraxinifolium Schott	Anacardiaceae	49	6	6	0,58	0,60	0,71	0,74	0,47	0,44	1,76	1,78
Syagrus flexuosa (Mart.) Becc.	Arecaceae	3111	12	6	1,16	0,60	1,14	0,88	0,33	0,18	2,63	1,66
Tabebuia aurea (Silva Manso) Benth & Hook f. ex S. Moore	Bignoniaceae	458	5	5	0,48	0,50	0,71	0,74	0,20	0,19	1,39	1,42
Copaifera langsdorffii Desf.	Fabaceae	580	3	4	0,29	0,40	0,43	0,59	0,26	0,36	0,98	1,35
Strychnos pseudoquina A.St.-Hil.	Loganiaceae	1526	2	2	0,19	0,20	0,28	0,29	0,94	0,70	1,42	1,19
Mimosa laticifera Rizzini & A.Mattos	Fabaceae	2032	5	4	0,48	0,40	0,57	0,59	0,16	0,12	1,21	1,11
Ouratea spectabilis (Mart.) Engl.	Ochnaceae	2372	5	4	0,48	0,40	0,71	0,59	0,14	0,10	1,34	1,09
Euplassa inaequalis (Pohl) Engl.	Proteaceae	2478	4	3	0,39	0,30	0,57	0,44	0,58	0,33	1,53	1,07
Brosimum gaudichaudii Trécul	Moraceae	2083	4	4	0,39	0,40	0,43	0,44	0,16	0,14	0,97	0,98
Annona coriacea Mart.	Annonaceae	76	6	3	0,58	0,30	0,71	0,44	0,35	0,17	1,65	0,91
Machaerium acutifolium (Vogel)	Fabaceae	1238	3	3	0,29	0,30	0,43	0,44	0,13	0,13	0,85	0,88
Rudgea viburnoides (Cham.) Benth.	Rubiaceae	2623	3	3	0,29	0,30	0,43	0,44	0,07	0,08	0,79	0,82
Magonia pubescens A.St.-Hil	Sapindaceae	2676	2	2	0,19	0,20	0,28	0,29	0,30	0,31	0,78	0,81
Vochysia rufa Mart.	Vochysiaceae	3083	2	2	0,19	0,20	0,28	0,29	0,27	0,26	0,75	0,75
Byrsonima coccolobifolia Kunth	Malpighiaceae	1618	2	2	0,19	0,20	0,28	0,29	0,28	0,25	0,75	0,75
Hymenaea stigonocarpa Mart. ex Hayne	Fabaceae	614	3	3	0,29	0,30	0,28	0,29	0,10	0,10	0,68	0,70
Ficus sp.	Moraceae	4034	1	2	0,10	0,20	0,14	0,29	0,03	0,12	0,27	0,61

Species	Families	Nº Herb.	N 2005	N 2008	DR 2005	DR 2008	FR 2005	FR 2008	DoR 2005	DoR 2008	VI 2005	VI 2008
Platypodium elegans Vogel	Fabaceae	1250	1	1	0,10	0,10	0,14	0,15	0.32	0,33	0,56	0,58
Tapura amazonica Poepp. & Endl.	Dichapetalaceae	900	2	2	0,19	0,20	0,28	0,29	0,07	0,08	0,55	0,57
Couepia grandiflora (Mart. & Zucc.) Benth.	Chrysobalanaceae	718	2	2	0,19	0,20	0,28	0,29	0,08	0,07	0,56	0,57
Styrax camporum Pohl	Styracaceae	2891	3	2	0,29	0,20	0,43	0,29	0,31	0,07	1,03	0,57
Qualea multiflora Mart.	Vochysiaceae	3040	3	2	0,29	0,20	0,43	0,29	0,08	0,06	0,80	0,56
Plathymenia reticulata Benth.	Fabaceae	2059	2	2	0,19	0,20	0,28	0,29	0,07	0,06	0,54	0,55
Ouratea hexasperma (A.St.-Hil.) Baill.	Ochnaceae	2361	2	2	0,19	0,20	0,28	0,29	0,04	0,04	0,52	0,53
Eugenia gemmiflora O.Berg	Myrtaceae	2270	2	2	0,19	0,20	0,28	0,29	0,05	0,03	0,53	0,53
Licania humilis Cham. & Schltdl.	Chrysobalanaceae	3563	1	2	0,10	0,20	0,14	0,29	0,02	0,03	0,26	0,53
Aspidosperma subincanum Mart.	Apocynaceae	174	1	1	0,10	0,15	0,14	0,16	0,24	0,25	0,48	0,49
Coccoloba sp.	Polygonaceae	9830	1	1	0,10	0,10	0,14	0,15	0,06	0,09	0,30	0,34
Peltogyne confertiflora (Mart. ex Hayne) Benth.	Fabaceae	634	1	1	0,10	0,10	0,14	0,15	0,06	0,06	0,30	0,31
Bowdichia virgilioides Kunth	Fabaceae	1166	1	1	0,10	0,10	0,14	0,15	0,06	0,05	0,30	0,30
Cybistax antisiphilitica (Mart.) Mart.	Bignoniaceae	420	1	1	0,10	0,10	0,14	0,15	0,08	0,05	0,32	0,30
Andira vermifuga (Mart.) Benth.	Fabaceae	1159	1	1	0,10	0,10	0,14	0,15	0,05	0,05	0,29	0,30
Polygalaceae - N.I.	Polygalaceae	1533	1	1	0,10	0,10	0,14	0,15	0,04	0,05	0,28	0,30
Pterodon emarginatus Vogel	Fabaceae	1260	1	1	0,10	0,10	0,14	0,15	0,04	0,04	0,27	0,29
Ficus enormis Mart. ex Miq.	Moraceae	2090	1	1	0,10	0,10	0,14	0,15	0,03	0,02	0,27	0,28
Pouteria aff. *gardneri* (Mart. & Miq.) Baehni	Sapotaceae	2719	1	1	0,10	0,10	0,14	0,15	0,02	0,02	0,26	0,27
Byrsonima basiloba A.Juss.	Malpighiaceae	1615	1	1	0,10	0,10	0,14	0,15	0,03	0,01	0,27	0,27
Cardiopetalum calophyllum Schltdl.	Annonaceae	95	2	1	0,19	0,10	0,28	0,15	0,06	0,01	0,53	0,27
Dalbergia miscolobium Benth.	Fabaceae	1196	1	1	0,10	0,10	0,14	0,15	0,03	0,01	0,27	0,27
Diospyros sericea A.DC.	Ebenaceae	953	1	1	0,10	0,10	0,14	0,15	0,02	0,01	0,26	0,27
Miconia albicans (Sw.) Triana	Melastomataceae	6913	2	1	0,19	0,10	0,28	0,15	0,07	0,01	0,55	0,27
Andira cujabensis Benth.	Fabaceae	1156	1	1	0,10	0,10	0,14	0,15	0,02	0,01	0,26	0,26
Aspidosperma nobile Müll.Arg.	Apocynaceae	173	1	1	0,10	0,10	0,14	0,15	0,02	0,01	0,26	0,26
Simarouba versicolor A. St.-Hil.	Simaroubaceae	6646	1	-	0,10	-	0,17	-	0,21	-	0,43	-
Dimorphandra mollis Benth.	Fabaceae	598	1	-	0,10	-	0,17	-	0,02	-	0,26	-
Cordiera elliptica (Cham.) Kuntze	Rubiaceae	6825	1	-	0,10	-	0,16	-	0,02	-	0,26	-
Total			1033	999	100	100	100	100	100	100	300	300

Table 2 – Parameters of dynamics in a woody community of a cerradão in Bacaba Park, Nova Xavantina, Mato Grosso, between 2002 and 2005, 2005 and 2008, and 2002 and 2008. Where: t = paired t-test, F = result of analysis of variance. Values in parentheses correspond to standard deviation. Different letters indicate differences at 5% significance level.

Parameters	2002	2005	2008	
Mortality rate ($\%.year^{-1}$)	5,52			t=3,62
		2,70		P=0,0003
		4,51		
Recruitment rate ($\%.year^{-1}$)	8,47			t=9,67
		2,00		P<0,0001
		5,87		
Average number of individuals (plot)	18,8 (5,6)	20,7 (5,7)	19,9 (5,4)	F= 1,33 P=0,2658
Basal área ($m^2.ha^{-1}$)	21,38^a (5,9)	23,56^a (7,5)	25,95^b (8,4)	F=4,78 P=0,0098

In a riparian forest in Distrito Federal, Oliveira & Felfili (2005) recorded intense reduction in total density and increase in basal area; they suggested that greater shading of the area would hinder the growth of heliophilous species. This could also be happening in our study area, since all species that entered the community between 2002 and 2008, such as *Diospyros sericea*, *Ficus enormis* and *Pouteria gardneri*, are typical of forests and the ones that left the community, such as *Dimorphandra mollis*, *Cordiera elliptica* and *Simarouba versicolor*, are typical of savanna formations and open environments (Tab. 1, Marimon-Junior & Haridasan 2005). Besides, of the eight species that exhibited higher recruitment (> 10 individuals) in the period from 2002 to 2008 (Tab. 3), at least six are typical of forests; and all species that exhibited higher mortality (> 10 individuals, Tab. 3) are typical of savanna and field vegetation (Ratter *et al.* 1973; Pott & Pott 1994; Oliveira-Filho & Ratter 1995; IBGE 2002; Durigan *et al.* 2004; Mendonça *et al.* 2008).

The ten most important species in 2008 represented *c.* 54% of the total importance value (IV) and of the total number of individuals sampled. In 2002 they represented 53% of IV and 51.7% of the total number of individuals sampled, and in 2005, 52% of IV and 51.5% of the total number of individuals (Table 1; Marimon-Junior & Haridasan 2005). In a riparian forest in Distrito Federal, Felfili (1993) observed that the ten most important species might be considered to be the ones that exhibit higher success exploiting resources of the habitat. Inventories carried out in forests and savannas of the Cerrado biome (Costa & Araújo 2001; Marimon *et al.* 2006; Kunz *et al.* 2009) reported that the species that have higher importance value also have higher number of individuals, as recorded in the present study.

The most important species (IV) in all three sampling periods was *Hirtella glandulosa*, which contributed with approximately 12% of the total number of individuals in 2002, 2005 and 2008, confirming the area as a savanna forest of *Hirtella glandulosa*, as described by Ratter (1971) and Ratter *et al.* (1973). *Tachigali vulgaris* (=*Sclerolobium paniculatum*) was the second most important species in all inventories, with 6.5% of the total number of individuals in 2002 (Marimon-Junior & Haridasan 2005), 8.2% in 2005 and 9.3% in 2008. *Xylopia aromatica* was the third most important species in all three inventories, with 7.5% of the total number of individuals in 2002 (Marimon-Junior & Haridasan 2005), 7.2% in 2005 and 6.3% in 2008. The species mentioned were also among the ten most important species in other savanna forest areas (Gomes *et al.* 2004; Pereira-Silva *et al.* 2004; Marimon *et al.* 2006; Guilherme & Nakajima 2007; Kunz *et al.* 2009) and in a dense savanna (Andrade *et al.* 2002), evidencing their broad distribution and high importance in different forests of the Cerrado biome.

Tachigali vulgaris has a short life cycle (< 20 years) and rapid growth (Felfili *et al.* 1999). In this case, it is suggested that the mortality of this species and the resulting fall of large-sized senile individuals, such as recorded by Franczak (2009) in

Table 3 – Number of dead and recruited individuals in the intervals between the years 2002 and 2005 (02-05), 2005 and 2008 (05-08), and 2002 and 2008 (02-08). Cerradão of the Bacaba Park, Nova Xavantina, MT. Species listed in descending order of number of individuals recruited between 2002 and 2008. Were considered only those species that presented at least five dead or recruited individuals at least in one interval.

Species	Dead			Recruited		
	(02-05)	(02-05)	(02-08)	(02-05)	(05-08)	(02-08)
Tachigali vulgaris	12	8	20	36	17	53
Hirtella glandulosa	5	0	5	14	5	19
Heisteria ovata	1	2	3	18	-	18
Sorocea klotzschiana	-	-	-	15	3	18
Tapirira guianensis	1	-	1	15	3	18
Siparuna guianensis	2	-	2	14	2	16
Xylopia aromatica	10	12	22	14	2	16
Chaetocarpus echinocarpus	-	-	-	11	1	12
Maprounea guianensis	-	-	-	8	1	9
Matayba guianensis	5	0	5	7	2	9
Cordiera sessilis	2	-	2	6	-	6
Myrcia splendens	6	1	7	5	1	6
Erythroxylum daphnites	4	3	7	5	-	5
Aspidosperma multiflorum	4	1	5	3	-	3
Guapira graciliflora	19	7	26	3	-	3
Antonia ovata	1	5	6	1	-	1
Eriotheca gracilipes	5	1	9	1	-	1
Guapira noxia	8	4	12	-	1	1
Roupala montana	8	10	18	1	-	1
Syagrus flexuosa	3	6	9	1	-	1
Annona coriacea	3	3	6	-	-	-

the studied savanna forest, cause gap openings, accelerating community dynamics and contributing to the maintenance of *T. vulgaris* and other species that demand similar light levels to establish and grow. In the present study, the increase in density of *T. vulgaris* between 2002 and 2008 is characterized by the ingression of juvenile individuals; and the increase in basal area, in addition to the juveniles that entered the community, was due to the fast growth of adults that still remained in the community: Miguel *et al.* (2011) recorded the highest absolute value of periodic annual increment (2.05 cm/year) for this species. Therefore, differently from what was observed in tropical forests subjected to abiotic environmental changes, such as the case of riparian forests submitted to the seasonal flood of rivers and to an intense edge effect (Felfili 1993; Miguel & Marimon 2008), the temporal changes recorded in the savanna forest studied may have a biotic origin, led by *Tachigali vulgaris*, which might be a keystone species in the dynamics of this savanna forest. Besides, considering that this species maintained itself in the same hierarchical position during the study period, possibly its adult and senile individuals, after falling, opened new gaps, maintaining the possibility of regeneration and growth of the species in a type of positive feedback or virtual circle (Miguel *et al.* 2011).

Based on this assumption, the contribution of *Tachigali vulgaris* may be important to several ecosystem processes that affect community structure, as for instance the microclimate, since microclimatic factors such as light, humidity and soil and air temperature depend on canopy characteristics, especially regarding the dynamics of gap formation (Guilherme 2000). In this case, forests with a highly dynamic canopy, as in the present study, undergo high levels of intermediate disturbance during a short period of time, revealing a selection of tree species that are best adapted to such environmental conditions, which could be considered, hence, best competitors (Lopes & Schiavini 2007). Therefore, changes in environmental conditions, on which *Tachigali vulgaris* seems to have an effective participation, are causing changes in the floristic composition and in the structure of the savanna forest under study.

Considering the ten most important species, only the first three in decreasing order (*Hirtella glandulosa*, *Tachigali vulgaris* and *Xylopia aromatica*) kept their IV position unchanged in 2002, 2005 and 2008 (Tab. 1; Marimon-Junior & Haridasan 2005). It is important to highlight that those species also exhibited the highest basal area values, occurred in higher frequency compared to others and were the only ones that exhibited relative density over 5%. Between 2002 and 2005, based on the study of Marimon-Junior & Haridasan (2005), nearly all species changed their hierarchical IV positions. This pattern of structural change in most species gives this savanna forest a very dynamic character compared to other Cerrado vegetation types (Felfili *et al.* 2000; Marimon 2005; Miguel & Marimon 2008). In this context, Baker *et al.* (2004) and Wright (2005) observed that changes in structure and species composition of tropical forests may have important implications in the carbon cycle and in the biodiversity of these forests.

Considering the ten most important species during the three periods of sampling, it was observed that *Eriotheca gracilipes* occupied the 4th IV position in the first inventory (2002), moved to the 9th position in 2005 and to the 12th position in 2008. Another remarkable change was recorded in the hierarchical position of *Roupala montana*, which moved from the 7th position in 2002 for the 10th position in 2005 and the 15th position in 2008. In this case, the species mentioned above, which are heliophilous (*E. gracilipes*) and pioneer (*R. montana*) (Franczak 2009), may have been affected by a possible partial closure of the canopy in the last period of the study (2005 to 2008). Whereas *Chaetocarpus echinocarpus*, which is a typical understory species (shady environments) from seasonal semideciduous and riparian forests of eastern Mato Grosso (Marimon *et al.* 2001; 2002), climbed from the 11th position in 2005 to the 7th position in 2008.

Ronquim *et al.* (2003) observed that *Eriotheca gracilipes* needs high solar radiation levels for growth (100% transmittance), under which it exhibits higher photosynthetic capacity and higher biomass accumulation. According to these authors, under shaded conditions (30% transmittance) *E. gracilipes* does not produce enough resources to sustain the demand required for the formation of reproductive structures. In this case, under natural conditions it would tolerate shading, but would remain in a vegetative state with reduced growth. According to Mendonça *et al.* (2008), *Roupala montana* is a species that occurs mainly in cerrado *sensu stricto*, "campo sujo", "campo de murundus" and rocky savanna *(cerrado rupestre)*. Felfili & Abreu (1999) recorded higher growth of *R. montana* under higher light conditions. Therefore, considering the ecological characteristics mentioned for these species and taking into account the changes in their hierarchical positions in the present study, it is suggested that the savanna forest studied here is closing.

The changes in IV in the community indicate that most species alternate frequently, as recorded by Carvalho (1992) and Felfili (1993) in Amazonian and riparian forests in central Brazil, indicating that these communities are in a dynamic state, varying in density and basal area of species over time.

Tree species such as *Tachigali vulgaris* may contribute not only to the understanding of complex ecological interactions of tropical forests, but also to studies on restoration of degraded areas. The restoration processes, which are usually difficult and long under the climatic conditions of central-western Brazil, require the indication of species that have the same success of establishment and growth in restoration areas that they have under natural conditions.

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